

English Version

## Pyrotechnic articles - Fireworks, Categories F1, F2 and F3 - Part 4: Test methods

Articles pyrotechniques - Artifices de divertissement,  
Catégories F1, F2 et F3 - Partie 4 : Méthodes d'essai

Pyrotechnische Gegenstände - Feuerwerkskörper,  
Kategorien F1, F2 und F3 - Teil 4: Prüfverfahren

This European Standard was approved by CEN on 8 August 2022.

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**CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels**

| <b>Contents</b>                                           | <b>Page</b> |
|-----------------------------------------------------------|-------------|
| European foreword .....                                   | 4           |
| 1 Scope.....                                              | 6           |
| 2 Normative references.....                               | 6           |
| 3 Terms and definitions .....                             | 6           |
| 4 Test environment .....                                  | 6           |
| 4.1 General.....                                          | 6           |
| 4.2 Indoor.....                                           | 6           |
| 4.3 Outdoor.....                                          | 7           |
| 4.3.1 General.....                                        | 7           |
| 4.3.2 Category F1.....                                    | 7           |
| 4.3.3 Category F2.....                                    | 7           |
| 4.3.4 Category F3.....                                    | 7           |
| 4.4 Monitoring height.....                                | 7           |
| 5 Apparatus .....                                         | 7           |
| 6 Methods of tests.....                                   | 12          |
| 6.1 Construction and stability .....                      | 12          |
| 6.1.1 Length of handle.....                               | 12          |
| 6.1.2 Attachment of separate handle or separate base..... | 13          |
| 6.1.3 Length of item.....                                 | 13          |
| 6.1.4 Length of pull-string or pull-strip .....           | 14          |
| 6.1.5 Determination of diameter .....                     | 14          |
| 6.1.6 Attachment of initial fuse.....                     | 14          |
| 6.1.7 Resistance to ignition by an abrasive surface ..... | 14          |
| 6.1.8 Breakability of end closures .....                  | 15          |
| 6.2 Design – Verification.....                            | 15          |
| 6.2.1 General.....                                        | 15          |
| 6.2.2 Conformity to drawings and part lists.....          | 15          |
| 6.2.3 Determination of net explosive content.....         | 16          |
| 6.3 Paper tests.....                                      | 17          |
| 6.3.1 Test for burning or incandescent matter .....       | 17          |
| 6.3.2 Test for horizontally projected debris .....        | 18          |
| 6.3.3 Test for vertically projected debris.....           | 20          |
| 6.4 Angle of ascent and height of explosion.....          | 21          |
| 6.4.1 Apparatus .....                                     | 21          |
| 6.4.2 Procedure for double banger .....                   | 22          |
| 6.4.3 Procedure for items other than double banger .....  | 22          |
| 6.5 Measurement of sound pressure level .....             | 22          |
| 6.5.1 General measurement for outdoors.....               | 22          |
| 6.5.2 Party popper.....                                   | 23          |
| 6.5.3 Christmas cracker and snap for indoors .....        | 24          |
| 6.6 Time measurement.....                                 | 25          |
| 6.6.1 Apparatus .....                                     | 25          |
| 6.6.2 Procedure .....                                     | 25          |
| 6.7 Measuring of labelling.....                           | 25          |

|                        |                                                                                                                                        |    |
|------------------------|----------------------------------------------------------------------------------------------------------------------------------------|----|
| 6.7.1                  | Apparatus .....                                                                                                                        | 25 |
| 6.7.2                  | Procedure .....                                                                                                                        | 25 |
| 6.8                    | Extinguishing of flames .....                                                                                                          | 26 |
| 6.8.1                  | Apparatus .....                                                                                                                        | 26 |
| 6.8.2                  | Procedure .....                                                                                                                        | 26 |
| 6.9                    | Burning rate of composition.....                                                                                                       | 26 |
| 6.9.1                  | Apparatus .....                                                                                                                        | 26 |
| 6.9.2                  | Procedure .....                                                                                                                        | 26 |
| 6.10                   | Droop test.....                                                                                                                        | 26 |
| 6.10.1                 | Apparatus .....                                                                                                                        | 26 |
| 6.10.2                 | Procedure .....                                                                                                                        | 26 |
| 6.11                   | Projected debris (outdoor) .....                                                                                                       | 26 |
| 6.11.1                 | Apparatus .....                                                                                                                        | 26 |
| 6.11.2                 | Procedure .....                                                                                                                        | 26 |
| 6.12                   | Incandescent matter.....                                                                                                               | 27 |
| 6.13                   | Visual and audible examinations.....                                                                                                   | 27 |
| 6.14                   | Mechanical conditioning.....                                                                                                           | 27 |
| 6.14.1                 | Apparatus .....                                                                                                                        | 27 |
| 6.14.2                 | Procedure .....                                                                                                                        | 27 |
| 6.15                   | Thermal conditioning .....                                                                                                             | 28 |
| 6.15.1                 | Apparatus .....                                                                                                                        | 28 |
| 6.15.2                 | Procedure .....                                                                                                                        | 28 |
| 6.16                   | Striking surface test.....                                                                                                             | 28 |
| 6.16.1                 | Apparatus .....                                                                                                                        | 28 |
| 6.16.2                 | Procedure .....                                                                                                                        | 28 |
| 6.17                   | Function test.....                                                                                                                     | 28 |
| 6.17.1                 | Apparatus .....                                                                                                                        | 28 |
| 6.17.2                 | Procedure .....                                                                                                                        | 28 |
| 6.18                   | Determination of tube angle.....                                                                                                       | 29 |
| 6.18.1                 | Apparatus .....                                                                                                                        | 29 |
| 6.18.2                 | Procedure .....                                                                                                                        | 29 |
| Annex A (informative)  | Mechanical conditioning (shock apparatus).....                                                                                         | 30 |
| Annex B (normative)    | Determination of silver fulminate .....                                                                                                | 33 |
| B.1                    | Reagents.....                                                                                                                          | 33 |
| B.2                    | Apparatus .....                                                                                                                        | 33 |
| B.3                    | Procedure .....                                                                                                                        | 33 |
| Annex ZA (informative) | Relationship between this European Standard and the essential<br>safety requirements of Directive 2013/29/EU aimed to be covered ..... | 35 |
| Bibliography           | .....                                                                                                                                  | 36 |

## European foreword

This document (EN 15947-4:2022) has been prepared by Technical Committee CEN/TC 212 “Pyrotechnic articles”, the secretariat of which is held by NEN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by April 2023, and conflicting national standards shall be withdrawn at the latest by April 2023.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN shall not be held responsible for identifying any or all such patent rights.

This document supersedes EN 15947-4:2015.

In comparison with the previous edition EN 15947-4:2015, the following technical modifications have been made:

- as a result of the inclusion of a new test method (6.1.8) two new apparatuses 5.28 “Dropping Tube” and 5.29 “Mass cylindrical in shape” were added;
- as a consequence of the inclusion of hand-held bengal flame (category F1) into the standard the titles for subclauses 6.1.1.2.1, 6.1.1.2.2 and 6.1.1.2.3 are changed into “6.1.1.2.1 Hand-held fireworks with uncoated ends as handles”, “6.1.1.2.2 Hand-held fireworks where the handle is an integral part of the body and not filled with pyrotechnic composition” and “6.1.1.2.3 Hand-held fireworks where the handle is a separate component and not filled with pyrotechnic composition”;
- a sentence to cover the testing of fuses fixed with adhesive tape for certain articles is added into subclause 6.1.6.2;
- a new test method under subclause 6.1.8 “Breakability of end closures” was added;
- Table 2 and Table 3 into subclause 6.3.1.2.2 are updated including all possible types;
- Figure 9 into subclause 6.5.2 has been revised, considering a new positioning of the sound meter with regards to the party popper;
- bullet point in subclause 6.14.1 has been removed and changes have been done into the whole subclause proposing an appropriate balance (5.7.3) fitting with the accuracy needed;
- “height of initial fuse for mounted wheels in category F3” has been removed.

This document has been prepared under a Standardization Request (M/583) concerning pyrotechnic articles given to CEN by the European Commission and the European Free Trade Association, and supports Essential Safety requirements of Directive 2013/29/EU.

For relationship with Directive 2013/29/EU, see informative Annex ZA, which is an integral part of this document.

This document is one of the series of standards as listed below:

- EN 15947-1, *Pyrotechnic articles — Fireworks, Categories F1, F2 and F3 — Part 1: Terminology*

- EN 15947-2, *Pyrotechnic articles — Fireworks, Categories F1, F2 and F3 — Part 2: Categories and types of firework*
- EN 15947-3, *Pyrotechnic articles — Fireworks, Categories F1, F2 and F3 — Part 3: Minimum labelling requirements*
- EN 15947-4, *Pyrotechnic articles — Fireworks, Categories F1, F2 and F3 — Part 4: Test methods*
- EN 15947-5, *Pyrotechnic articles — Fireworks, Categories F1, F2 and F3 — Part 5: Requirements for construction and performance*

Any feedback and questions on this document should be directed to the users' national standards body. A complete listing of these bodies can be found on the CEN website.

According to the CEN-CENELEC Internal Regulations, the national standards organisations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Republic of North Macedonia, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Türkiye and the United Kingdom.

## 1 Scope

This document specifies test methods. It is applicable to fireworks of the categories F1, F2 and F3 as defined by Article 6 Paragraph (1) clause (a) subclause (i) to (iii) of Directive 2013/29/EU.

## 2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 15947-1:2022, *Pyrotechnic articles — Fireworks, Categories F1, F2 and F3 — Part 1: Terminology*

EN 15947-3:2022, *Pyrotechnic articles — Fireworks, Categories F1, F2 and F3 — Part 3: Minimum labelling requirements*

EN 15947-5:2022, *Pyrotechnic articles — Fireworks, Categories F1, F2 and F3 — Part 5: Requirements for construction and performance*

EN 61672-1:2013, *Electroacoustics — Sound level meters — Part 1: Specifications*

EN ISO 3696:1995, *Water for analytical laboratory use — Specification and test methods (ISO 3696:1987)*

ISO 4793:1980, *Laboratory sintered (fritted) filters — Porosity grading, classification and designation*

ISO 6344-3:2013, *Coated abrasives — Grain size analysis — Part 3: Determination of grain size distribution of microgrits P240 to P2500*

ISO 21948:2001, *Coated abrasives — Plain sheets*

## 3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 15947-1:2022 apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at <https://www.electropedia.org/>
- ISO Online browsing platform: available at <https://www.iso.org/obp/ui>

## 4 Test environment

### 4.1 General

The test area shall be a clean, flat, horizontal, non-flammable and sound reflecting surface (for example concrete). The test sample shall be placed in accordance with the instructions on the label in the centre of the test area.

### 4.2 Indoor

The test area shall be indoors.

The test area shall be inside a fume cupboard, or similar enclosed space, which is capable of preventing movement of air.

## 4.3 Outdoor

### 4.3.1 General

The test area shall be an outdoor site. If applicable, provisions shall be made at the centre of the test area for partially burying into the ground.

If applicable, insert support pole in the centre of the test area.

### 4.3.2 Category F1

A test area meeting the requirements given in 4.1, with a radius of at least 2,0 m and a circle, radius 1,0 m, shall be marked around the centre of the test area.

### 4.3.3 Category F2

A test area meeting the requirements given in 4.1, with a radius of at least 9,0 m and a circle, radius 8,0 m, shall be marked around the centre of the test area.

### 4.3.4 Category F3

A test area meeting the requirements given in 4.1, with a radius of at least 16,0 m and a circle, radius 15,0 m, shall be marked around the centre of the test area.

## 4.4 Monitoring height

Two positions in the same horizontal plane for monitoring the height of ascent and angle of flight shall be provided, at a measured distance of at least 50 m from and at an angle of 90° to each other in relation to the testing point.

## 5 Apparatus

The described apparatuses are only examples, any equivalent apparatus with the same accuracy or better can be used.

### 5.1 Timing device

**5.1.1 Timing device**, capable of being read to the nearest 0,1 s.

**5.1.2 Timing device**, capable of being read to the nearest 1 min.

**5.2 Calliper**, flat faced vernier calliper reading to 0,1 mm.

**5.3 Ruler**, reading to 1 mm.

**5.4 Measuring tape**, reading to 10 mm.

**5.5 Wind speed meter**, capable to measure with accuracy of at least 0,5 m/s.

### 5.6 Masses with clamping device

**5.6.1 Masses with clamping device**,  $(50 \pm 1,0)$  g mass total.

**5.6.2 Masses with clamping device**,  $(100 \pm 1,0)$  g mass total.

**5.6.3 Masses with clamping device**,  $(500 \pm 1,0)$  g mass total.

## **5.7 Balance**

**5.7.1 Balance**, reading to 100 mg.

**5.7.2 Balance**, reading to 10 mg.

**5.7.3 Balance**, reading to 0,1 mg.

**5.8 Abrasive sheet**, large enough to permit striking of the ignition head, conforming to ISO 21948:2001, grit P240 measured in accordance with ISO 6344-3:2013.

## **5.9 Temperature chamber**

**5.9.1 Temperature chamber**, up to  $(+130 \pm 2,5) ^\circ\text{C}$ .

**5.9.2 Temperature chamber**, up to  $(+75 \pm 2,5) ^\circ\text{C}$ .

**5.9.3 Temperature chamber**, up to  $(+50 \pm 2,5) ^\circ\text{C}$ .

**5.10 Test paper**, 700 mm × 750 mm,  $(80 \pm 3,0) \text{ g/m}^2$ .

## **5.11 Clamping device**

Means of clamping to hold different test sample at different heights and/or angles.

**5.12 Plate**, non-flammable, with a diameter of  $(200 \pm 5) \text{ mm}$ .

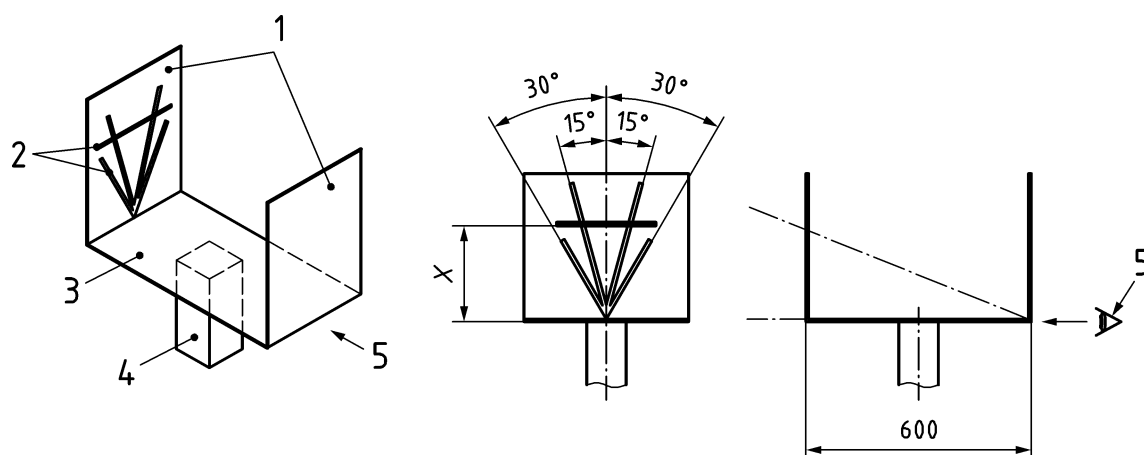
## **5.13 Paper holder**

Means of clamping to fix the test paper in a horizontal or vertical plane in different heights.

## **5.14 Viewing screen**

Viewing screens, as shown in Figure 1, shall be provided for monitoring height and angle of flight criteria. A configuration for height monitoring is given in Figure 2.

Dimensions in millimetres

**Key**

- 1 acryl glass
- 2 black tape, 10 mm to 20 mm wide
- 3 solid base
- 4 stand
- 5 position of observer

**Figure 1 — Viewing screen - general view, observer view and side view**

The distance X in Figure 1 is given in metres by the Formula (1):

$$\frac{20 \text{ m}}{X} = \frac{Y}{0,6 \text{ m}} \quad (1)$$

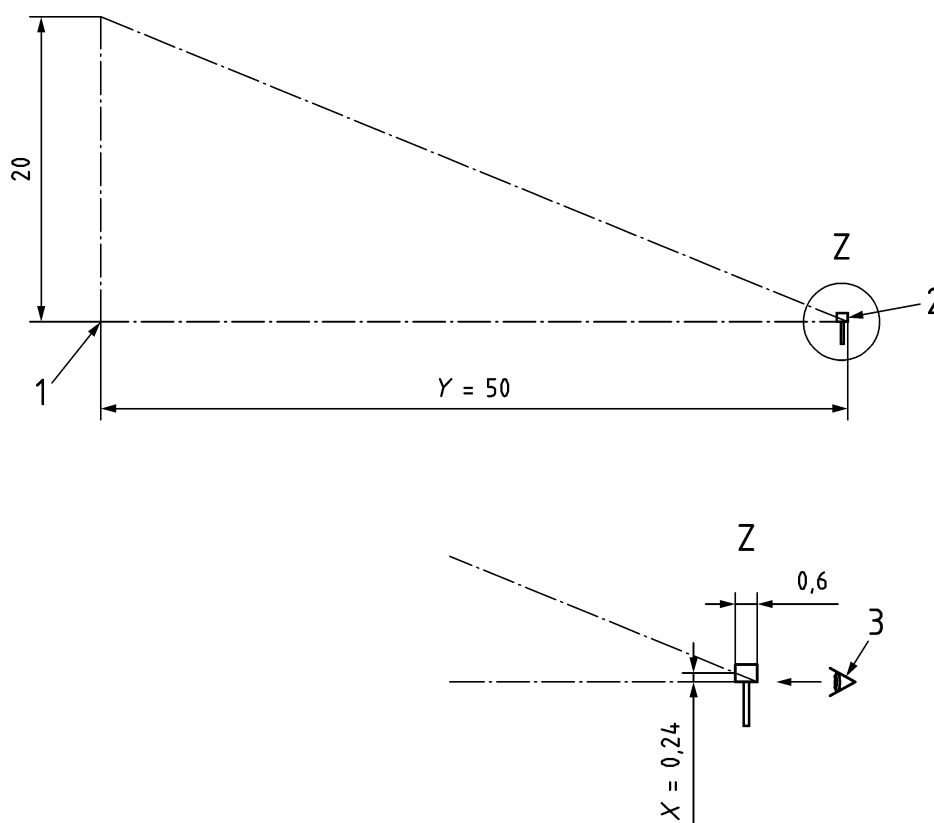
where

Y is the distance in metres from the viewing point to the testing point.

EXAMPLE Y = 50 m

$$X = \frac{0,6 \text{ m} \cdot 20 \text{ m}}{Y} = \frac{0,6 \text{ m} \cdot 20 \text{ m}}{50 \text{ m}} = 0,24 \text{ m}$$

Dimensions in meters

**Key**

- 1 base of firework before firing
- 2 sighting device
- 3 position of observer

**Figure 2 — Use of a viewing screen to monitor a height of 20 m - side view and sighting device detail**

**5.15 Poles**, with 3 m height.

**5.16 Rack**

Horizontal plate with a central hole of 800 mm diameter, mounted in a height of 3,0 m above the ground in a rack.

**5.17 Sound level meter**, class 1 of EN 61672-1:2013 with free-field microphone.

**5.18 Shock apparatus**, shall provide a deceleration of  $490^{+100}_{-50}$  m/s<sup>2</sup> (when measured at the centre of an unloaded platform) and the mechanical conditioning impulse duration (time elapsed from the starting of the machine's deceleration to the time in which the deceleration reaches its maximum value during each first shock pulse) shall be  $2 \text{ ms} \pm 1 \text{ ms}$  working at a frequency of  $1 \text{ Hz} \pm 0,1 \text{ Hz}$ .

**NOTE** An example of an apparatus is shown in Annex A.

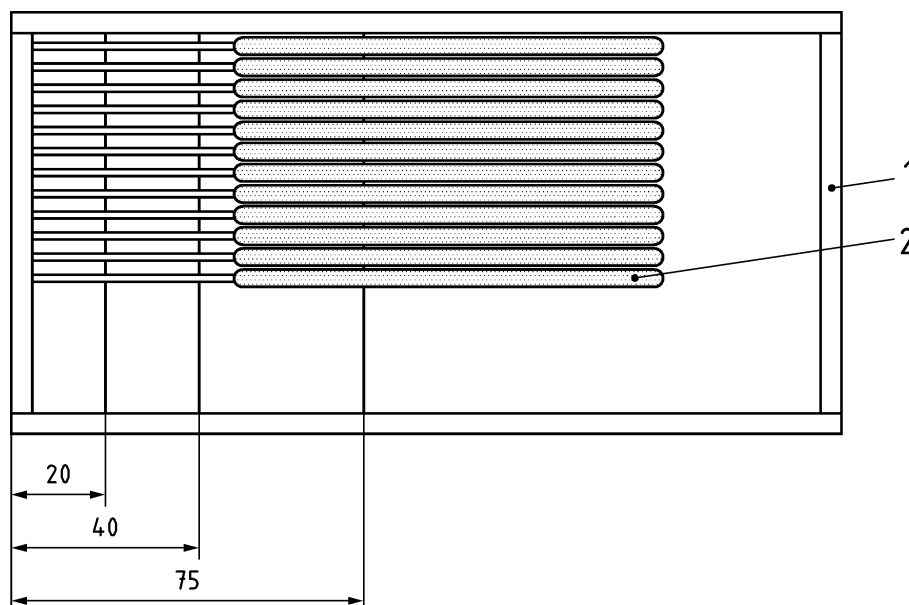
**5.19 Goniometer**, read to 1°.

## 5.20 Frame

The frame shall retain the test sample consistently.

To gauge the length of the handles, clearly marked lines shall be marked at distances of 20 mm, 40 mm and 75 mm from the handle end of the frame.

Dimensions in millimetres



### Key

- 1 frame
- 2 fireworks, e.g. sparkler

**Figure 3 — Example for determining length of handles (batch test) - top view**

**5.21 Ignition source**, capable of producing a small flame or of smouldering.

## 5.22 Transparent type size sheet

The printing, as required in EN 15947-3:2022, 4.6 shall comply with the size shown in Figure 4 as shown below.

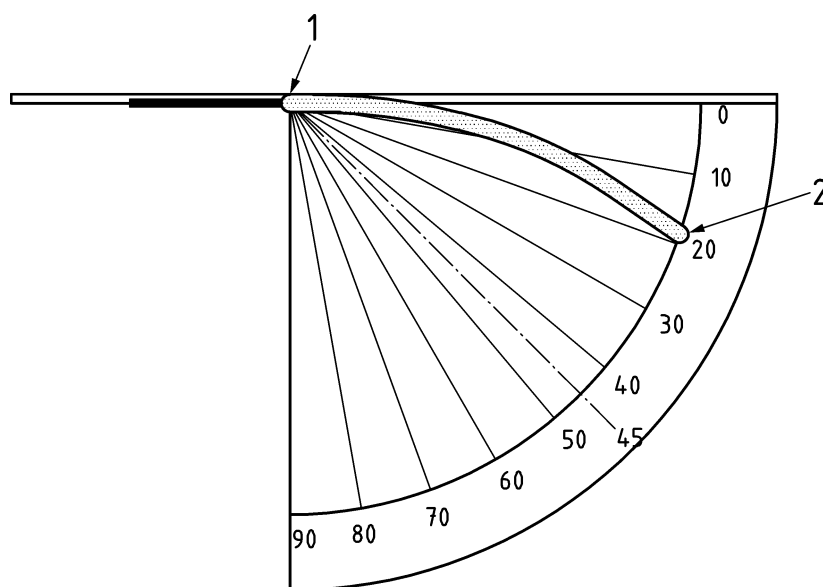
2,8 mm: ABC abc XYZ xyz 123

2,1 mm: ABC abc XYZ xyz 123

**Figure 4 — Type size of print**

The size of the printing of the transparent type size sheet shall be verified by the use of a calliper (5.2).

## 5.23 Protractor



### Key

- 1 junction of handle/pyrotechnic composition
- 2 tip of hand-held sparkler

**Figure 5 — Measurement of droop**

**5.24 Striking surface** provided with or as part of the primary pack.

**5.25 Post**, with a height of  $(0,50 \pm 0,01)$  m.

**5.26 Cage**, thin-wire cage with a mesh size of 10 mm to 15 mm.

The wire shall have a diameter of approximately 1,0 mm.

The inner length and width shall be  $(200 \pm 10)$  mm. The inner height of the cage shall be  $(100 \pm 10)$  mm.

**5.27 Support pole**, with a height of  $(1,75 \pm 0,25)$  m.

**5.28 Dropping tube**, with a smooth inside wall (e. g. made of plastics or aluminium) with a height of  $(725 \pm 25)$  mm, outer diameter of at least 27,0 mm and inner diameter of  $(25,0 \pm 1,0)$  mm. One of the ends of the tube shall be shaped or cut at an angle of  $(45 \pm 5)^\circ$ .

**5.29 Mass cylindrical in shape**,  $(100 \pm 1,0)$  g mass, with a diameter of  $(20,0 \pm 2,0)$  mm, made of metal.

## 6 Methods of tests

### 6.1 Construction and stability

#### 6.1.1 Length of handle

##### 6.1.1.1 Apparatus

— Calliper (5.2);

- ruler (5.3);
- frame (5.20).

### **6.1.1.2 Procedure**

#### **6.1.1.2.1 Hand-held fireworks with uncoated ends as handles**

For type test measure and record the length of the uncoated end using the calliper (5.2) if the length of the handle is smaller than or equal to 100 mm or using the ruler (5.3) if the length exceeds 100 mm.

For batch test measure the length of the uncoated end by using the calliper (5.2), the ruler (5.3) or the frame (5.20) to determine the length of the uncoated end and record if the length of uncoated end is within the requirements.

If using the frame (5.20), place the fireworks with the handles in accordance with Figure 3 and record whether and if so, for how many items, the uncoated end is less than the required length.

#### **6.1.1.2.2 Hand-held fireworks where the handle is an integral part of the body and not filled with pyrotechnic composition**

Carry out the type test using the fireworks that are used for determination of the net explosive content. Cut open the marked end of the firework case. Using calliper (5.2), measure and record the length of the firework case which is not filled with pyrotechnic composition to the nearest 1,0 mm.

#### **6.1.1.2.3 Hand-held fireworks where the handle is a separate component and not filled with pyrotechnic composition**

Carry out the type test using the fireworks that are used for determination of the net explosive content. Cut open the marked end of the firework case. Using calliper (5.2), measure and record the length of the separate handle to the nearest 1,0 mm.

### **6.1.2 Attachment of separate handle or separate base**

#### **6.1.2.1 Apparatus**

- Timing device (5.1.1);
- weight (5.6.3).

#### **6.1.2.2 Procedure**

Clamp the sample by means of a clamping device in a position such that the handle respectively base of the sample is pointing vertically downwards. Securely attach the 500 g weight (5.6.3) to the handle respectively base.

Using the timing device (5.1.1) determine and record the time until the handle respectively base of the sample becomes detached. If this time is longer than 10 s, stop the test and record as “longer than 10 s”.

### **6.1.3 Length of item**

#### **6.1.3.1 Apparatus**

- Ruler (5.3).

#### **6.1.3.2 Procedure**

Use the ruler (5.3) to measure and record the total length of the test item to the nearest 1 mm.

#### **6.1.4 Length of pull-string or pull-strip**

##### **6.1.4.1 Apparatus**

- Ruler (5.3).

##### **6.1.4.2 Procedure**

Carefully extend the pull-string or pull-strip to its full length without firing the test item. Using the ruler (5.3), measure the total exposed length of the pull-string or pull-strip. Record the length.

#### **6.1.5 Determination of diameter**

##### **6.1.5.1 Apparatus**

- Calliper (5.2).

##### **6.1.5.2 Procedure**

Using the calliper (5.2), measure the inside diameter of the tube at least three times at different positions to the nearest 1,0 mm.

Using the calliper (5.2), measure the outer diameter of the tube of the mini rocket at least three times at different positions to the nearest 0,5 mm.

Record the individual diameters and calculate the mean diameter.

#### **6.1.6 Attachment of initial fuse**

##### **6.1.6.1 Apparatus**

- 50 g mass with clamping device (5.6.1);
- 100 g mass with clamping device (5.6.2);
- timing device (5.1.1).

##### **6.1.6.2 Procedure**

Fix the firework in such a position that the initial fuse is pointing vertically downwards. The mass with clamping device (5.6.1 or 5.6.2) shall be attached to the end of the fuse. Any fixation elements like adhesive tape or similar shall not be removed. If testing a category F1 firework or a category F2 mini rocket, securely attach the 50 g mass with clamping device (5.6.1) to the initial fuse. If testing a category F2 firework other than a mini rocket or a category F3 firework, securely attach the 100 g mass with clamping device (5.6.2) to the initial fuse.

Using the timing device (5.1.1), determine and record the time until the initial fuse becomes detached. If this time is longer than 10 s stop the test and record as "longer than 10 s".

#### **6.1.7 Resistance to ignition by an abrasive surface**

##### **6.1.7.1 Apparatus**

- Abrasive sheet (5.8).

##### **6.1.7.2 Procedure**

Strike the friction head of the test sample in the test area (4.2 or 4.3) on the rough surface of the abrasive sheet (5.8). Record whether the friction head ignites.

### 6.1.8 Breakability of end closures

#### 6.1.8.1 Apparatus

- Dropping tube (5.28);
- 100 g mass cylindrical in shape (5.29);
- balance, reading 100 mg (5.7.1).

#### 6.1.8.2 Procedure

After dismantling (according to 6.2), take an undamaged piece of end closure for testing (usually with a cylindrical shape and without rests of paper, cardboard, etc.) and place it on a flat side on a firm horizontal surface (e. g. concrete or metal surface). Set up the dropping tube (5.28) vertically above the sample with the diagonal cut end of the dropping tube touching the surface and let the 100 g mass (5.29) fall through the dropping tube in such a way that the mass does not touch the inner side of the tube. If the end closure breaks, take the biggest resulting fragment and measure its weight using the balance (5.7.1). If the sample does not break, repeat the test with the end closure laid lengthwise on the same horizontal surface. Prevent the end closure to roll away when the mass hits the sample. Take the undamaged piece or the biggest resulting fragment of the end closure and measure its mass using the balance (5.7.1). If the mass is bigger than 8,0 g record the measured weight.

In total a minimum of three end closures and at least one of each calibre used in a fireworks article shall be tested. This test does not apply to end closures with diameters smaller than  $(20,0 \pm 0,5)$  mm.

## 6.2 Design – Verification

### 6.2.1 General

These tests shall be done for type testing in “as-received” condition.

### 6.2.2 Conformity to drawings and part lists

#### 6.2.2.1 Apparatus

- calliper (5.2);
- ruler (5.3);
- balance (5.7).

#### 6.2.2.2 Procedure

The tested firework shall be in accordance with the relevant manufacturing drawing. The drawing shall show any relevant component with its dimensions, the masses of each pyrotechnic charge as well as the detailed pyrotechnic composition of the firework.

Measure and record all relevant external dimensions of the firework according to 6.1.3 using the calliper (5.2) or the ruler (5.3). Measure and record the outer diameter and the inside diameter of the tubes, if any, according to 6.1.5.

Measure and record the gross mass of the firework by using the balance (5.7).

Conformity to specific requirements mentioned into EN 15947-5:2022, 4.1.2, 6.2 and 7.1.2.1, as well as other external characteristics shown into the drawings and part lists (e.g. shape, ancillary elements such as provided supports, external identifiable parts, number of elements in batteries and combinations, etc.) shall be assessed according to 6.13 by means of visual examination.

Observe and record any nonconformity.

### 6.2.3 Determination of net explosive content

#### 6.2.3.1 Apparatus

- Timing device (5.1.2);
- balance 10 mg (5.7.2);
- balance 100 mg (5.7.1);
- temperature chamber (5.9.1).

#### 6.2.3.2 Procedure

##### 6.2.3.2.1 Determination by dismantling

Carefully dismantle the test sample.

The accuracy of weighing shall be in accordance with Table 1 according to the mass of pyrotechnic composition as given in the relevant manufacturing drawings.

**Table 1 — Accuracy of weighing**

| Mass of pyrotechnic composition | Weigh to the nearest | Using the balance |
|---------------------------------|----------------------|-------------------|
| ≤ 3,0 g                         | 10 mg                | 5.7.2             |
| > 3,0 g                         | 100 mg               | 5.7.1             |

Weigh the pyrotechnic composition not contained in pyrotechnic unit(s). Record the mass.

If possible, remove the pyrotechnic composition from each pyrotechnic unit, separate bursting charge, report charge and effect charge and weigh each portion. Record the mass of each portion. Record the number of units containing report charge, if applicable.

##### 6.2.3.2.2 Determination by separation of pyrotechnic composition by water/solvent

Weigh at least five test samples to the nearest 100 mg, using the balance (5.7.1). Note the mass. Subsequently place the test samples in water or an appropriate solvent depending on the pyrotechnic composition until all pyrotechnic compositions are soaked and easy to remove. Wash the inert material with the chosen solvent until there is no adherent composition and dry it in a temperature chamber at 120 °C (5.9.1) for 1 h measured using a timing device (5.1.2). Weigh the inert material after a cooling period of 2 h measured using a timing device (5.1.2) at room temperature to the nearest 100 mg, using the balance (5.7.1). Record the mass.

Calculate the mean net explosive content of the pyrotechnic composition as the difference between the initial mass and the mass of the sample without any composition divided by the number of samples. Record the mean net explosive content of the pyrotechnic composition.

##### 6.2.3.2.3 Determination of silver fulminate

The test method for the determination of silver fulminate is given in Annex B.

## **6.3 Paper tests**

### **6.3.1 Test for burning or incandescent matter**

#### **6.3.1.1 Apparatus**

- Ruler (5.3);
- test paper (5.10);
- clamping device (5.11);
- plate (5.12);
- goniometer (5.19);
- ignition source (5.21).

#### **6.3.1.2 Procedure**

##### **6.3.1.2.1 General**

Place the sheet of paper (5.10) on a horizontal area (4.2). When testing table bomb, serpent, flash pellet, indoor non-hand-held sparkler or indoor fountain, place the plate (5.12) in the middle of the test paper and place the sample on the plate. If the sample is not fitted with a base, then use the clamping device (5.11) to fix the sample at the required angle and height to the test paper.

##### **6.3.1.2.2 Test configuration**

The test configuration is given in Table 2. An additional test configuration for fountain (hand-held, for indoor use) and table bomb is given in Table 3.

Ignite the test sample, in accordance with the instructions on the label, using the ignition source (5.21).

After functioning, remove the sample, the plate and the clamping device, if any.

Record whether the test paper caught fire and/or has holes burnt in it.

**Table 2 — Test configuration**

| Article                                 | Angle of test sample (5.19)   | Height of test sample above test paper (5.10) | Distance of sample to the test paper (5.10) |
|-----------------------------------------|-------------------------------|-----------------------------------------------|---------------------------------------------|
| fountain (for indoor use)               | vertical                      | direct on the plate                           |                                             |
| hand-held sparkler (for indoor use)     | horizontal                    | (200 ± 10) mm                                 |                                             |
| non hand-held sparkler (for indoor use) | vertical<br>in supplied stand | direct on the plate                           |                                             |
| bengal match                            | horizontal                    | (200 ± 10) mm                                 |                                             |
| novelty match                           | horizontal                    | (200 ± 10) mm                                 |                                             |
| serpent                                 | vertical                      | direct on the plate                           |                                             |
| flash pellet                            | vertical                      | direct on the plate                           |                                             |
| party popper                            | horizontal                    |                                               | (500 ± 10) mm                               |

**Table 3 — Additional test configuration for fountain (hand-held, for indoor use) and table bomb**

| Article                              | Angle of test sample (5.19) | Height of test paper (5.10) above test samples (additionally to the test paper (5.10) below the test sample) |
|--------------------------------------|-----------------------------|--------------------------------------------------------------------------------------------------------------|
| fountain (hand-held, for indoor use) | vertical                    | (500 ± 10) mm                                                                                                |
| table bomb                           | vertical                    | (1 500 ± 30) mm                                                                                              |

### 6.3.2 Test for horizontally projected debris

#### 6.3.2.1 Apparatus

- Ruler (5.3);
- test paper (5.10);
- clamping device (5.11);
- paper holder (5.13);
- goniometer (5.19);
- ignition source (5.21).

#### 6.3.2.2 Procedure

Use the clamping device (5.11) to fix the test sample at the specified height, measured with the ruler (5.3), and angle, measured with the goniometer (5.19), above the centre of the test paper (5.10).

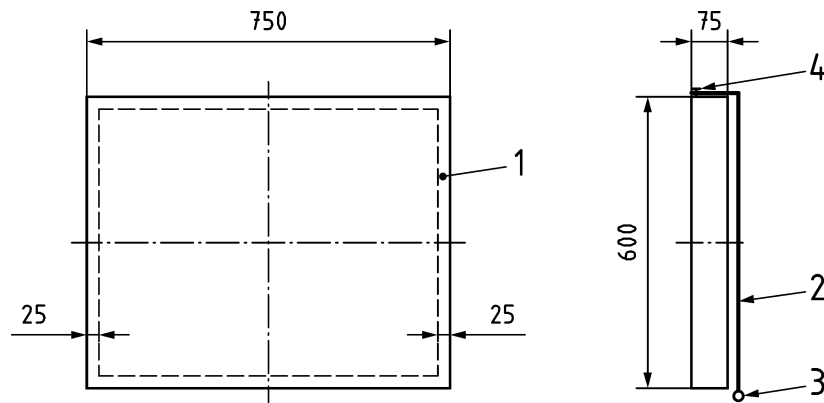
Use paper holder (5.13) to fix the test paper (5.10) vertically. Use ruler (5.3) to adjust the paper holder in the required position and distance.

Function the test sample in accordance with the labelled instructions with an appropriate ignition source (5.21). In case of party popper pull the string to fire the party popper.

Record whether any ejected material penetrated the sheet of test paper, or whether the ejected material or test paper caught fire.

Examples of configuration are given in Figure 6 and Figure 7.

Dimensions in millimetres

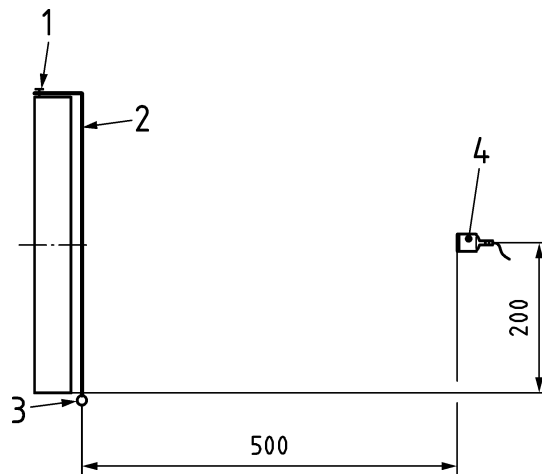


#### Key

- 1 paper holder
- 2 sheet of paper
- 3 weighted rod
- 4 paper clamp

**Figure 6 — Example of paper holder - front view and side view**

Dimensions in millimetres

**Key**

- 1 paper clamp
- 2 sheet of paper
- 3 weighted rod
- 4 party popper

**Figure 7 — Arrangement for party popper performance test - side view****6.3.3 Test for vertically projected debris****6.3.3.1 Apparatus**

- Ruler (5.3);
- test paper (5.10);
- clamping device (5.11);
- plate (5.12);
- paper holder (5.13);
- goniometer (5.19);
- ignition source (5.21).

**6.3.3.2 Procedure**

Use the clamping device (5.11) to fix the test sample at the specified height, measured with the ruler (5.3), and angle, measured with goniometer (5.19), above the centre of the test paper.

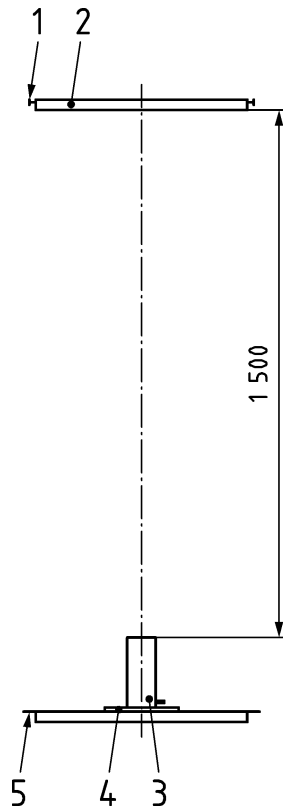
Use paper holder (5.13) to fix the test paper (5.10) horizontally. Use ruler (5.3) to adjust the paper holder to the required position and distance.

Ignite the test sample on the non-flammable plate (5.12) in accordance with the labelled instructions by using the ignition source (5.21).

Record whether any ejected material penetrated the sheet of test paper and whether any ejected material were made of glass or sharp metal, or whether the ejected material or either sheet of test paper caught fire.

An example of configuration is given in Figure 8 below.

Dimensions in millimetres



#### Key

- 1 paper holder
- 2 test paper
- 3 table bomb
- 4 non-flammable plate
- 5 test paper

**Figure 8 — Arrangement for table bomb performance test - front view**

## 6.4 Angle of ascent and height of explosion

### 6.4.1 Apparatus

- Viewing screen (5.14);
- poles (5.15);
- rack (5.16);
- ignition source (5.21);
- post (5.25).

#### 6.4.2 Procedure for double banger

Position the rack (5.16) such that the centre of the 800 mm hole is directly above the centre of the test area. Place the double banger in accordance with the labelled instructions in the centre of the test area and ignite by using the ignition source (5.21).

Observe and record whether the double banger passes through the hole in the horizontal plate. Observe and record the height where the second report occurs.

#### 6.4.3 Procedure for items other than double banger

Place one or more posts (5.25) inside the test area (4.3.2) with the related radius.

Two observers with viewing screens are positioned in accordance with 4.4 so that the bottom edge of the triangle on the screen aligns with the base of the test sample, and the bottom edge of the back screen aligns with the bottom edge of the horizontal tape on the front screen.

Ignite the sample in accordance with the labelled instructions by using the ignition source (5.21).

Record whether the angle of ascent and the height of the effects of explosion of the test sample were within the limits specified according to EN 15947-5:2022, 7.2.3.

Record whether any burning matter was extinguished at the specified height according to EN 15947-5:2022, 7.2.9, by using the poles (5.15).

Record whether any bursts or explosions occurred at a height of less than the specified height according to EN 15947-5:2022, 7.2.6, by using the viewing screen (5.14).

Observe and record if ground mover, ground spinner and jumping ground spinner move outside the safety distance. For ground spinners observe and record if the height exceeds the height of the posts (5.25).

### 6.5 Measurement of sound pressure level

#### 6.5.1 General measurement for outdoors

##### 6.5.1.1 Apparatus

- Sound level meter (5.17);
- measuring tape (5.4).

##### 6.5.1.2 Procedure

The measurement of the sound pressure level shall be carried out outdoors for all fireworks of category F1, F2 and F3 except for party popper, Christmas cracker and snap.

Set up the microphone of the sound level meter (5.17) in the test area (4.2 or 4.3) at the required distance and at a height of 1,0 m.

- a) For category F1, the microphone is set up at a horizontal distance of 1 m from the testing point.
- b) For category F2, the microphone is set up at a horizontal distance of 8 m from the testing point.
- c) For category F3, the microphone is set up at a horizontal distance of 15 m from the testing point.

Record the maximum A-weighted impulse sound pressure levels as measured by the sound level meter (5.17).

For ground spinner, jumping cracker, jumping ground spinner and ground mover 10 extra measurements of sound pressure level shall be performed with the item fixed to the firing point by a cage (5.26) which ensures no movement of more than 0,1 m to all directions.

## 6.5.2 Party popper

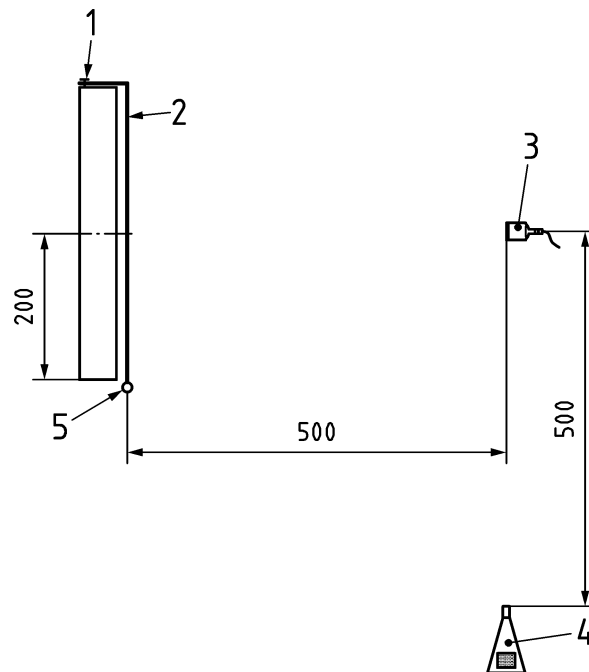
### 6.5.2.1 Apparatus

- Sound level meter (5.17);
- ruler (5.3).

### 6.5.2.2 Procedure

Set up the microphone of the sound level meter (5.17) in the test area (4.2) at a height of  $(200 \pm 10)$  mm above the surface, determined by the ruler (5.3) and at a horizontal distance of 500 mm from the sample and at  $90^\circ$  from the direction of firing (see Figure 9), determined by the ruler (5.3), see Figure 9.

Dimensions in millimetres



#### Key

- 1 paper holder
- 2 sheet of paper
- 3 party popper
- 4 sound level meter
- 5 weighted rod

**Figure 9 — Test arrangement for party popper indoors including measurement of sound pressure level - side view with schematic positioning for sound level meter**

Unfold the pull-string, if necessary, and extend the pull-string to its full length. Pull the string sharply. If the pull-string breaks, record the fact and do not proceed with further testing of that party popper. Observe and record whether the party popper produces a single report.

Record the maximum A-weighted impulse sound pressure as measured by the sound level meter (5.17).

### 6.5.3 Christmas cracker and snap for indoors

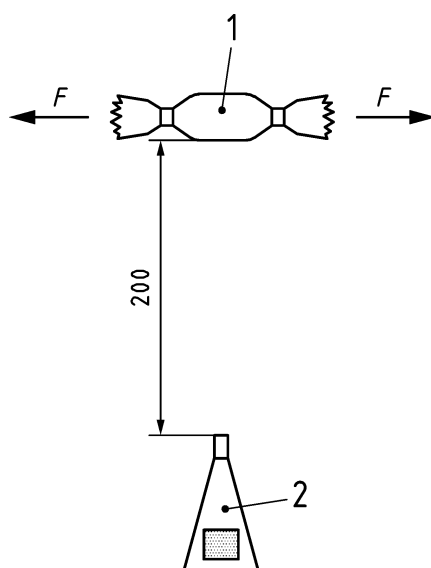
#### 6.5.3.1 Apparatus

- Sound level meter (5.17);
- ruler (5.3).

#### 6.5.3.2 Procedure

Set up the microphone of the sound level meter (5.17) in the test area (4.2) at a height of  $(200 \pm 10)$  mm above the surface, determined by the ruler (5.3) and at a horizontal distance of 200 mm from the sample, determined by the ruler (5.3), see Figure 10.

Dimensions in millimetres



#### Key

- 1 Christmas cracker/snap
- 2 sound level meter
- F applied force

**Figure 10 — Arrangement of sound level measuring - top view**

Pull the Christmas cracker or snap sharply. Observe and record whether the Christmas cracker or snap produces a single report.

If the pull-strip breaks, record the fact and do not proceed with further testing of that Christmas cracker or snap.

Record the maximum A-weighted impulse sound pressure as measured by the sound level meter (5.17).

## **6.6 Time measurement**

### **6.6.1 Apparatus**

- Timing device (5.1.1);
- ignition source (5.21);
- striking surface (5.24).

### **6.6.2 Procedure**

#### **6.6.2.1 Ignition time**

Remove any protection of initial fuse and ignite in accordance with the instructions for use.

Apply the ignition source (5.21) to the initial fuse and at the same instant, start the timing device (5.1.1). Stop the intermediate time at the moment the initial fuse ignites. If the initial fuse fails to ignite within the required time in accordance with EN 15947-5:2022, 6.4, record the fact and do not proceed with further testing of that firework.

If the firework has a friction head, strike the friction head of the firework on the striking surface (5.24), supplied with the firework. If the firework fails to ignite at the first strike try it twice more. Record if the firework did not ignite at one of the three strikes.

#### **6.6.2.2 Initial fuse burning time**

Initial fuse burning time shall be measured by using the timing device (5.1.1) and shall be recorded from the moment the initial fuse ignites to the time the firework starts to produce its principal effect or preliminary effect, if any.

#### **6.6.2.3 Invisible burning time**

If the preliminary effect is different from the first principal effect, measure and record the invisible burning time after the preliminary effect, if any, by using the timing device (5.1.1).

#### **6.6.2.4 Delay time for compound firework**

Measure the delay time between the single fireworks in the compound firework (time between end of effect of one firework and start of functioning of the next firework) using the timing device (5.1.1) and check and record if 15 s are exceeded.

## **6.7 Measuring of labelling**

### **6.7.1 Apparatus**

- Calliper (5.2);
- transparent type size sheet (5.22).

### **6.7.2 Procedure**

Using the calliper (5.2) or the transparent type size sheet (5.22), record whether the type sizes are correct and the printing is legible.

## **6.8 Extinguishing of flames**

### **6.8.1 Apparatus**

- Timing device (5.1.1).

### **6.8.2 Procedure**

After the firework has ceased to function, when tested according to 6.17, start the timing device (5.1.1) immediately and record the time until any flames caused by the functioning of the fireworks are extinguished.

## **6.9 Burning rate of composition**

### **6.9.1 Apparatus**

- Timing device (5.1.1).

### **6.9.2 Procedure**

Immediately after starting the principal effect of the fireworks start the timing device (5.1.1) and stop after the end of the principal effect and record the time.

Calculate the burning rate by using the net explosive content in accordance with 6.2.3 or the technical documentation in grams divided by the measured time in seconds. Record the burning rate in grams per second.

## **6.10 Droop test**

### **6.10.1 Apparatus**

- Clamping device (5.11)
- protractor (5.23);
- goniometer (5.19).

### **6.10.2 Procedure**

After functioning test according to 6.17 remove the hand-held sparkler from the clamping device (5.11) and use it for the measurement of the droop.

Measure the deflection of the unsupported tip from the horizontal, as shown in Figure 5, using the protractor (5.23) or the goniometer (5.19). Record the droop angle from the horizontal.

## **6.11 Projected debris (outdoor)**

### **6.11.1 Apparatus**

- Balance (5.7.1).

### **6.11.2 Procedure**

Record whether any debris is projected laterally more than the relevant safety distance according to EN 15947-5:2022, 7.2.11, during functioning.

Record whether there is any debris of metal projected.

For rocket and aerial wheel, collect any debris which appears to have a mass exceeding the specified limits according to EN 15947-5:2022, 7.2.11. Measure with the balance (5.7.1) and record any particle of debris which exceeds the specified mass.

### **6.12 Incandescent matter**

During functioning test according to 6.17 observe by visual examination according to 6.13 and record whether any burning or incandescent matter falls to the ground outside the relevant safety distance.

### **6.13 Visual and audible examinations**

The visual examination shall be done by naked eye and shall verify the requirements for this inspection.

The audible inspection shall be done at the relevant safety distance and shall verify the requirements for this inspection.

Record any nonconformities.

### **6.14 Mechanical conditioning**

#### **6.14.1 Apparatus**

- Shock apparatus (5.18);
- balance capable of weighing to an accuracy 0,1 mg (5.7.3);
- timing device (5.1.2).

#### **6.14.2 Procedure**

Place a sheet of paper on the platform of the mechanical shock apparatus (5.18). Place the amount of test samples as specified in EN 15947-5:2022, 9.1 and 9.2, on the top of the sheet of paper. For test samples supplied in primary packs in order to protect the initial fuse of the test sample, use complete, unopened packs. Cover the test samples or packs with the cellular rubber sheet and secure it to the platform around its edges. Start the machine so that the deceleration of each shock is  $490^{+100}_{-50} \text{ m}^2/\text{s}$  and the duration of each shock impulse is  $(2 \pm 1) \text{ ms}$ . Continue running the machine with a frequency of  $(1 \pm 0,1) \text{ Hz}$  for 1 h and control the running time by using the timing device (5.1.2).

At the end of the 1 h period stop the machine and remove the test samples or primary packs. For samples which have been conditioned in primary packs, carefully open the packs, remove the samples and empty any loose material on to the sheet of paper. Separate any pyrotechnic composition from the loose material and weight this pyrotechnic composition with the balance (5.7.3).

Record the mass of the pyrotechnic composition and whether any firework is damaged to an extent that could potentially affect their functioning.

Record whether there was any damaged or loose sealing paper, ignition head or friction head.

For throwdown, record whether any of the samples have exploded. Observe visually and record whether there is any damage to the primary pack and whether it has opened and whether any material has fallen out.

## **6.15 Thermal conditioning**

### **6.15.1 Apparatus**

- Temperature chamber (5.9.2 respectively 5.9.3);
- timing device (5.1.2).

### **6.15.2 Procedure**

Store the fireworks for 48 h (5.1.2) at a temperature of  $(75,0 \pm 2,5) ^\circ\text{C}$  or for 28 days (5.1.2) at a temperature of  $(50,0 \pm 2,5) ^\circ\text{C}$  in the temperature chamber (5.9.2 respectively 5.9.3) and then for at least two days at ambient temperature before testing. For fireworks which were supplied in primary packs, condition the fireworks by storing the appropriate number of complete, unopened packs.

Record whether any firework presents signs of ignition or if a visible chemical reaction occurred.

Record whether any firework is damaged to an extent affecting its functioning.

## **6.16 Striking surface test**

### **6.16.1 Apparatus**

- Striking surface (5.24).

### **6.16.2 Procedure**

All samples shall be ignited with the striking surface (5.24) in accordance with the instructions for use. Observe and record whether all samples were ignited. In case the samples are supplied in a primary pack all samples from the primary pack shall be ignited with the striking surface (5.24) in accordance with the instructions for use. Observe and record whether all samples were ignited.

## **6.17 Function test**

### **6.17.1 Apparatus**

- Wind speed meter (5.5), if applicable.
- ignition source (5.21);
- support pole (5.27).

### **6.17.2 Procedure**

In case of using the outdoor test area (4.3) the wind speed shall be measured using the wind speed meter (5.5) at a height of 1,5 m above the ground. No function test shall be carried out if the wind speed exceeds 5,0 m/s.

Place and ignite test sample in accordance to the instructions for use by using the ignition source (5.21).

For wheel without a support delivered by the manufacturer: place one support pole (5.27) in the centre of the test area (4.3). The centre of the wheel shall be attached to the support pole (5.27) so that it can rotate at a height of  $(1,75 \pm 0,25)$  m in the intended direction.

Test conditions for fireworks equipped with two or more fuses: The number of test samples shall be equally divided using the initial fuse and reserve fuse(s) for igniting, where possible. In case of type tests only, the same applies to the respective conditions (as-received, thermal and mechanical).

Observe and record the test results as required by EN 15947-5:2022, 7.2.

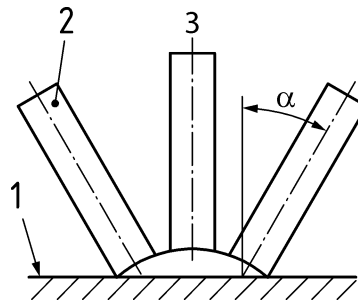
## 6.18 Determination of tube angle

### 6.18.1 Apparatus

— Goniometer (5.19).

### 6.18.2 Procedure

For determination of the tube angle use the function tested sample according to 6.17 and dismantle the sample in such a way, that the angle of the tube can be measured (see Figure 11) with the goniometer (5.19). Record the angle between the vertical and the centre line of the tube.



#### Key

- 1 base of firework
- 2 tube of mine, Roman candle or shot tube
- 3 centre line
- $\alpha$  tube angle

**Figure 11 — Determination of tube angle - cross section**

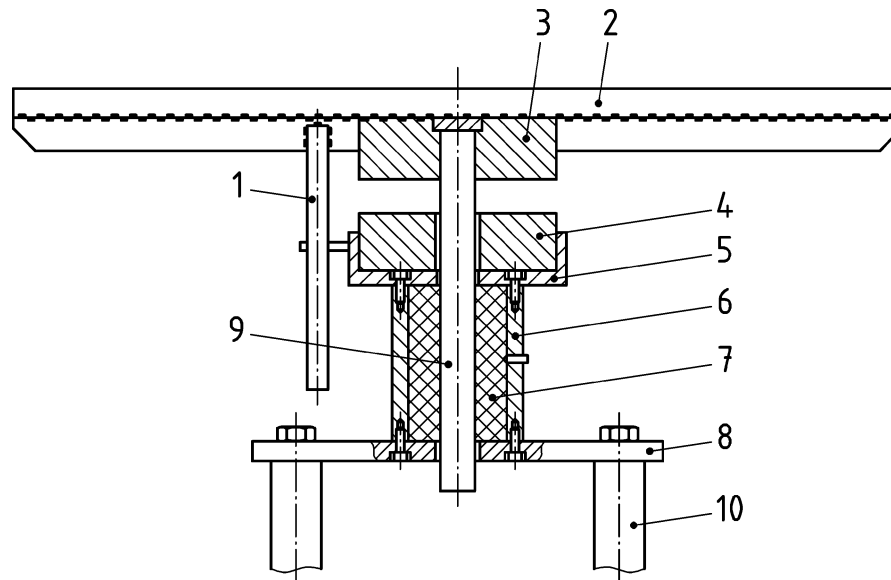
## Annex A (informative)

### Mechanical conditioning (shock apparatus)

Illustrated in the following figures (Figure A.1, Figure A.2 and Figure A.3), comprising the following components:

- a) **flat horizontal platform**, made of steel, 800,0 mm × 600,0 mm, 2,0 mm to 3,0 mm thick, with a 3,0 mm thick rim having a height of 15,0 mm; the platform is reinforced with eight steel ribs, 5,0 mm thick with a height of 30,0 mm, which are welded to the underside and run from the centre to each of the four corners and to the middle of each edge;
- b) **20,0 mm thick plate of fibreboard**, firmly attached to the platform by screws;
- c) **cylindrical steel boss**, diameter 125,0 mm and height 35,0 mm, located under the centre of the platform;
- d) **284,0 mm long shaft**, with diameter of 20,0 mm, fixed to the centre of the boss;
- e) **restraining peg**, to prevent the platform from rotating; the mass of the platform assembly [items a) to e)] shall be  $(23 \pm 1)$  kg;
- f) **annular, elastomeric pressure spring**, with a Shore A hardness of 68, when determined in accordance with EN ISO 868:2003, outside diameter 125,0 mm, inside diameter 27,0 mm and height 32,0 mm, on which the cylindrical boss will rest;
- g) **shallow steel cylinder**, inside diameter 126,0 mm, wall thickness 5,0 mm, outside height 30,0 mm, with a base 8,0 mm thick which has a 25,0 mm diameter hole drilled through the centre, to contain the elastomeric spring;
- h) **supporting steel cylinder**, outside diameter 80,0 mm, inside diameter 60,1 mm and height 92,4 mm, to which the shallow cylinder is screwed;
- i) **PVC liner**, outside diameter 60,0 mm, inside diameter 20,2 mm and height 92,4 mm, located inside the supporting cylinder and attached by a screw;
- j) **steel mounting plate**, thickness 12,0 mm with a 25,0 mm hole drilled through the centre, to which the supporting steel cylinder is screwed;
- k) **steel base plate**, thickness 12,0 mm;
- l) **four supporting pillars**, height 260,0 mm and diameter 32,0 mm, screwed to the mounting plate and to the base plate;
- m) **framework**, to support the based plate so that the complete assembly is at a convenient height;
- n) **attachment to the shaft**, allowing adjustment to the overall length, fitted with a cam wheel, outside diameter 30,0 mm, with a contact surface 8,0 mm wide;
- o) **cylindrical cam**, outside diameter 120,0 mm, inside diameter 100,0 mm, wall thickness 10,0 mm, with a “vertical drop” of 50,0 mm between the high point and the low point;

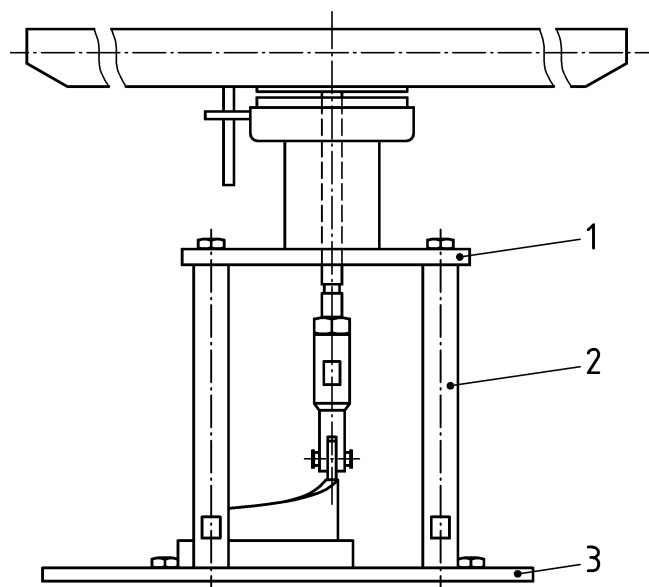
- p) **collar**, outside diameter 50,0 mm, height 4,0 mm;
- q) **electric motor and suitable gearing**, to rotate the cam at a rotational frequency of 1 Hz;
- r) **cellular rubber sheet**, 100,0 mm thick. The material used shall have an apparent density when determined in accordance with EN ISO 845:2009, of 35 kg/m<sup>3</sup> and an indentation hardness check, when determined in accordance with EN ISO 2439:2008 of 215 N.



**Key**

- 1 restraining peg
- 2 platform
- 3 boss
- 4 pressure spring
- 5 cup
- 6 supporting cylinder
- 7 PVC liner
- 8 mounting plate
- 9 shaft
- 10 supporting pillar

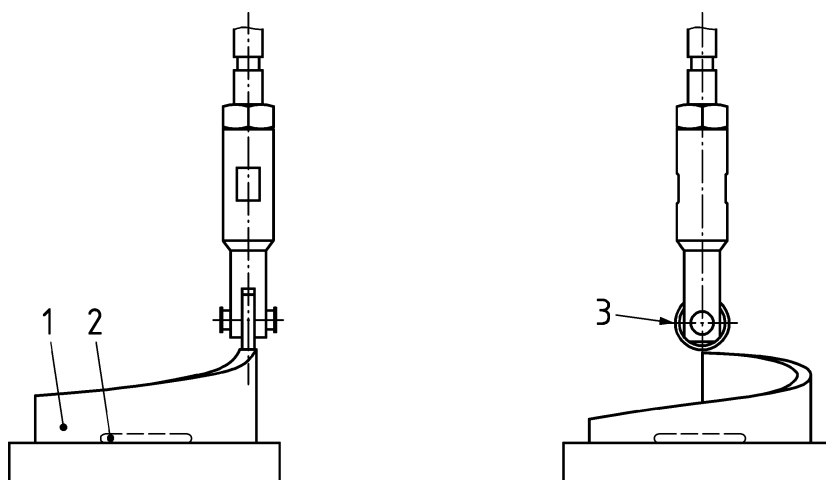
**Figure A.1 — Detail of top section of mechanical shock apparatus - cross section**



**Key**

- 1 mounting plate
- 2 supporting pillar
- 3 base plate

**Figure A.2 — General assembly of mechanical shock apparatus - front view**



**Key**

- 1 cam
- 2 collar
- 3 cam wheel

**Figure A.3 — Detail of shaft attachment and cam assembly of mechanical shock apparatus from left to right - front view and side view**

## **Annex B**

### **(normative)**

## **Determination of silver fulminate**

### **B.1 Reagents**

- Purified water, conforming to grade 3 of EN ISO 3696:1995;
- concentrated ammonia solution;
- nitric acid solution, 10 g/100 ml;
- hydrochloric acid solution, 5 g/100 ml.

### **B.2 Apparatus**

- Laboratory balance, capable of weighing to the nearest 0,1 mg (5.7.3);
- beaker, 100 ml;
- beaker, 200 ml;
- filter funnel;
- filter paper;
- glass filter crucible with a porous glass filter grade P16 conforming to ISO 4793:1980;
- scalpel;
- timing device (5.1.2);
- temperature chamber up to  $(130 \pm 2,5) ^\circ\text{C}$  (5.9.1).

### **B.3 Procedure**

Select a random of:

- a) 50 novelty matches from the primary pack. Carefully cut out the segment of the sticks which is covered with report composition using the scalpel;
- b) 50 snaps or throwdowns from the primary pack. Remove them carefully from the paper.

Put the parts from a) or b) in a 100 ml beaker and wet it with 30 ml of purified water and 20 ml of the ammonia solution. Warm the solution while stirring continuously, and transfer the hot solution quantitatively to the filter funnel containing the filter paper into the 200 ml beaker and wash the residue with purified water.

Dilute the filtrate with 100 ml of purified water. Acidify the diluted filtrate by carefully adding the nitric acid solution and heat it until boiling. While stirring contentiously, add the hydrochloric acid solution drop by drop until no further precipitate is formed.

Store the solution with the precipitate in the dark for 3 h (5.1.2). Weigh the glass filter crucible to the nearest 0,1 mg, using the balance (5.7.3) and record the mass ( $m_0$ ). Filter the precipitate through the glass filter crucible and wash it with purified water until the washings are neutral. Dry the filter crucible for 1 h (5.1.2) at 130 °C (5.9.1). Allow the crucible with the residue to cool down to room temperature, weigh it to the nearest 0,1 mg, using the balance (5.7.3) and record the mass ( $m_1$ ).

Calculate the mean mass, in milligrams, of silver fulminate per sample from the following Formula B.1:

$$\bar{m} = 1,0456 \left( \frac{m_1 - m_0}{50} \right) \quad (\text{B.1})$$

Record the mean mass of silver fulminate.

## Annex ZA (informative)

### Relationship between this European Standard and the essential safety requirements of Directive 2013/29/EU aimed to be covered

This European Standard has been prepared under a Commission's standardization request M/583 "Standardization mandate assigned to CEN concerning pyrotechnic articles" to provide one voluntary means of conforming to essential safety requirements of Directive 2013/29/EU of the European Parliament and of the Council of 12 June 2013 on the harmonization of the laws of the Member States relating to the making available on the market of pyrotechnic articles (recast).

Once this standard is cited in the Official Journal of the European Union under that Directive 2013/29/EU, compliance with the normative clauses of this standard confers, within the limits of the scope of this standard, a presumption of conformity with the corresponding essential safety requirements of that Directive 2013/29/EU, and associated EFTA regulations.

**Table ZA.1 — Correspondence between this European Standard and Directive 2013/29/EU**

| Essential safety Requirements (ESRs) of Directive 2013/29/EU | Clause(s)/subclause(s) of this EN | Remarks/Notes |
|--------------------------------------------------------------|-----------------------------------|---------------|
| 3. 2 <sup>nd</sup> and 3 <sup>rd</sup> sentence              | Clause 6 and Annex B              |               |

**WARNING 1** — Presumption of conformity stays valid only as long as a reference to this European Standard is maintained in the list published in the Official Journal of the European Union. Users of this standard should consult frequently the latest list published in the Official Journal of the European Union.

**WARNING 2** — Other Union legislation may be applicable to the product(s) falling within the scope of this standard.

## Bibliography

- [1] EN 15947-2:2022, *Pyrotechnic articles — Fireworks, Categories F1, F2 and F3 — Part 2: Categories and types of firework*
- [2] EN ISO 845:2009, *Cellular plastics and rubbers — Determination of apparent density (ISO 845:2006)*
- [3] EN ISO 868:2003, *Plastics and ebonite — Determination of indentation hardness by means of a durometer (Shore hardness) (ISO 868:2003)*
- [4] EN ISO 2439:2008, *Flexible cellular polymeric materials — Determination of hardness (indentation technique) (ISO 2439:2008)*